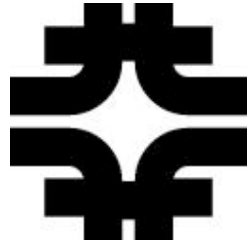


# *Computing at Fermilab*

D. Petravick

Fermilab

August 16, 2007



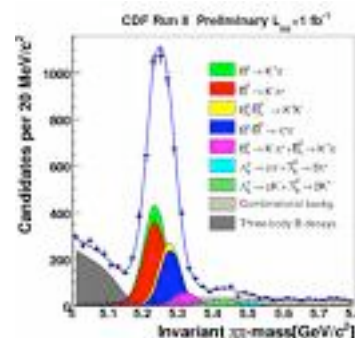
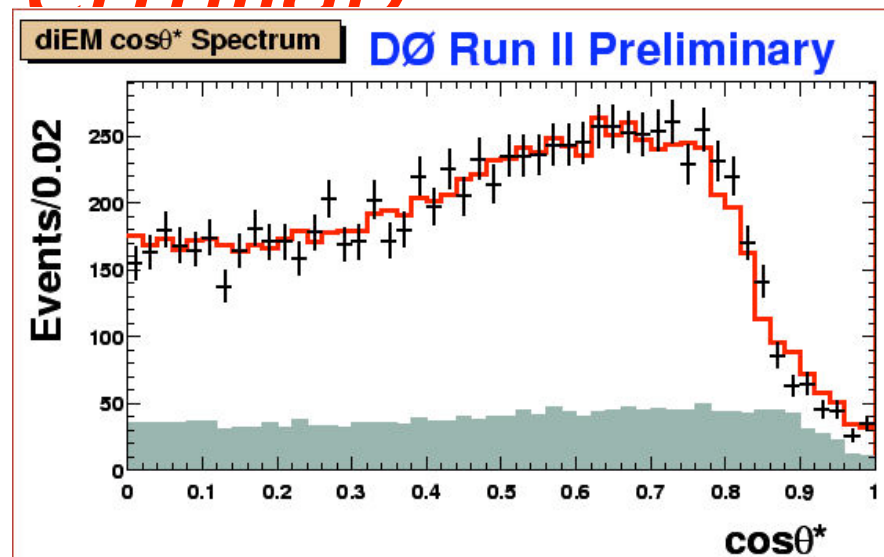
# *FNAL Scientific Computing*

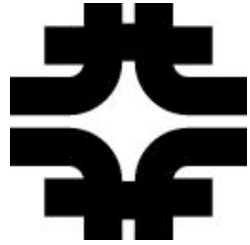
- CDF
- D0
- Lattice QCD
- CMS Tier 1 center
- Experimental Astrophysics
- Theoretical Astrophysics
  - partner w/Kavli Inst. U Chicago
- Accelerator Simulations
- Neutrino Program



# HEP Computing at Fermilab

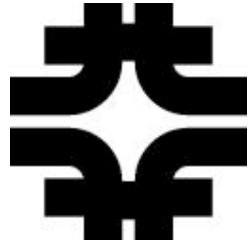
- Fermilab has a substantial and long established program in capacity computing as part of its experimental HEP program.
- Roughly
  - Event simulation
  - online filtering (1:10,000)
  - “production” (instrumental -> physical)
  - Analysis -- study of the data.





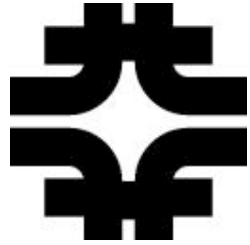
## *HEP software environment*

- Large Codes, large frameworks, shared between tasks, variety of languages
  - Benefits from homogenous development and deployment environments.
  - Lap/desktop -> into framework -> batch
  - Codes are likely larger, more complex than many HPC codes.
- Environment is overwhelmingly linux.
  - Scant traction for other environments.
  - Codes are likely larger, more complex than many HPC codes.



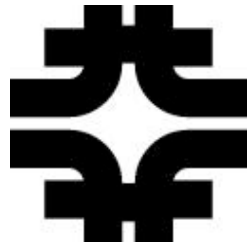
## *Lattice at Fermilab*

- National collaboration oversees computing resources.
  - Group see roles for DOE Exascale and local computing.
  - Relatively large amount of shared data, techniques.
  - Configurations re-used by different groups.
- 3000 cores at Fermilab
  - Cluster approach
  - Coupled with Myrinet and Infiniband.
  - Additional procurement Federal FY 08-09.



# *Cosmological Computing*

- *Cosmological simulations are powerful tools to understand the growth of structure in the universe... is essential for extracting precision information about fundamental physics such as dark energy and dark matter from upcoming astronomical surveys.*
- Roadmap calls for
  - Formation of larger collaborations
  - Computational methods and data are more diverse than lattice.
  - 10000 cores by 2012.
  - 12 PB data requirement

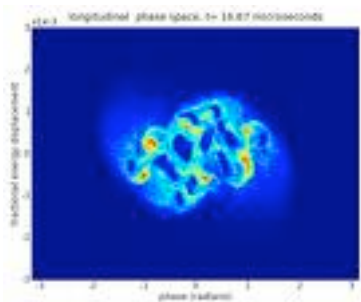


## *Other elements of lab program*



SDSS Lensing

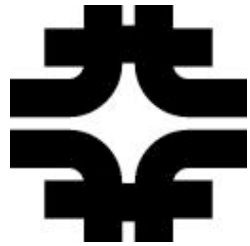
- Not mentioned in this overview:
  - Experimental Astrophysics (Sloan Digital Sky Survey, Dark Energy Survey)
  - Other Element of Theoretical Astrophysics
  - Accelerator simulations
  - Neutrino program



Synergia Simulation  
Of bunching in the  
Tevatron

Element of  
CDMS  
detector





# *Significant campus Storage and Data Movement*

~6.5 PB on tape.

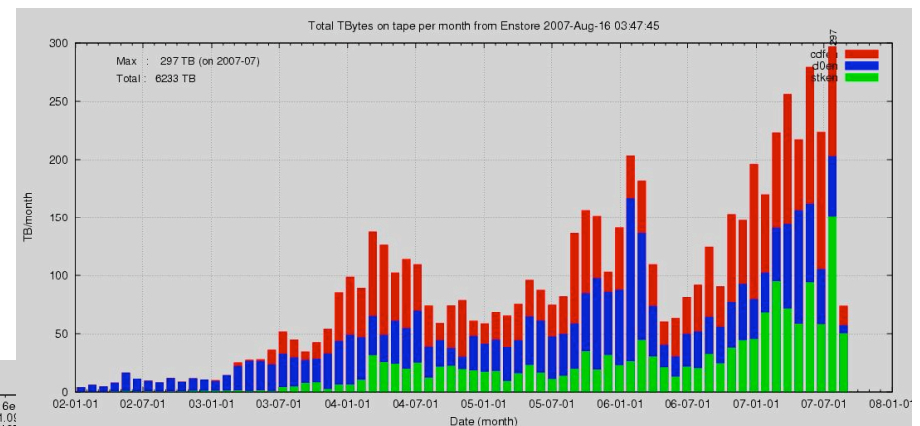
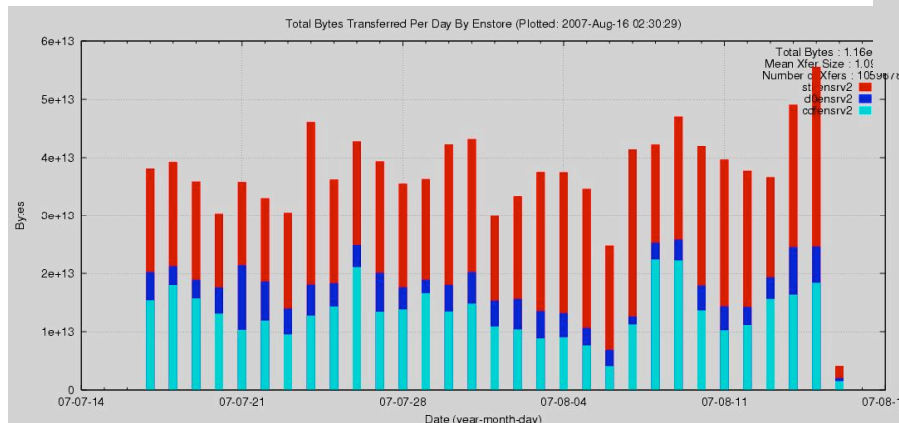
Few PB of disk

Ethernet SAN

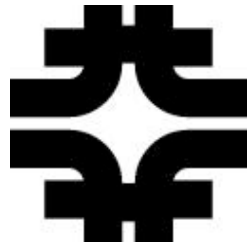
> 40 gbps disk movement

300 T/mo  
ingest

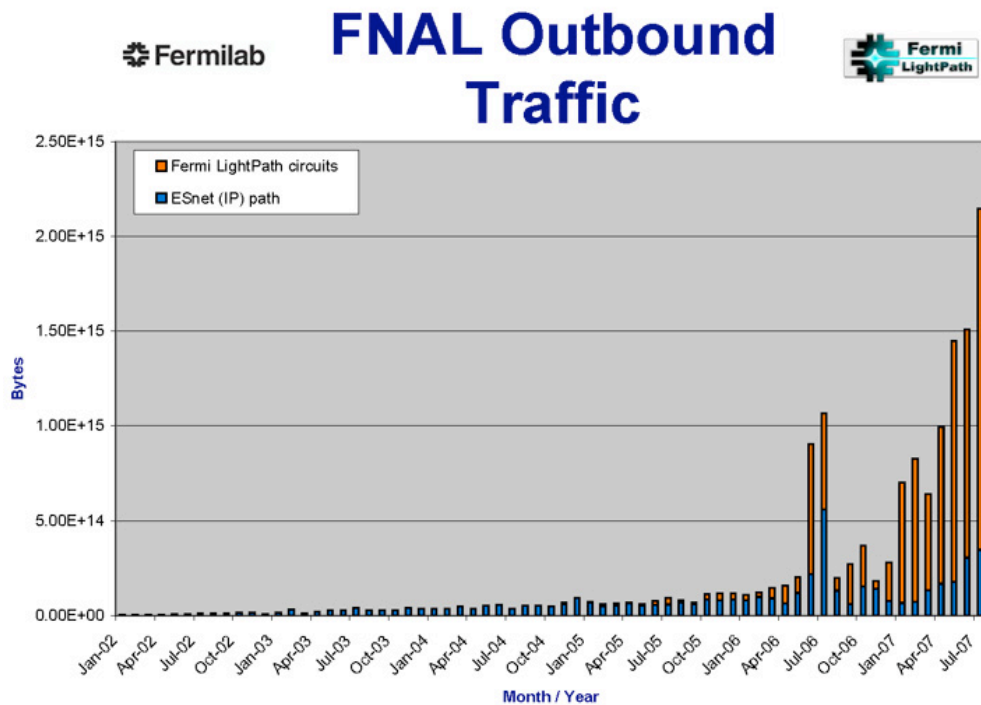
~60/TB day tape movment





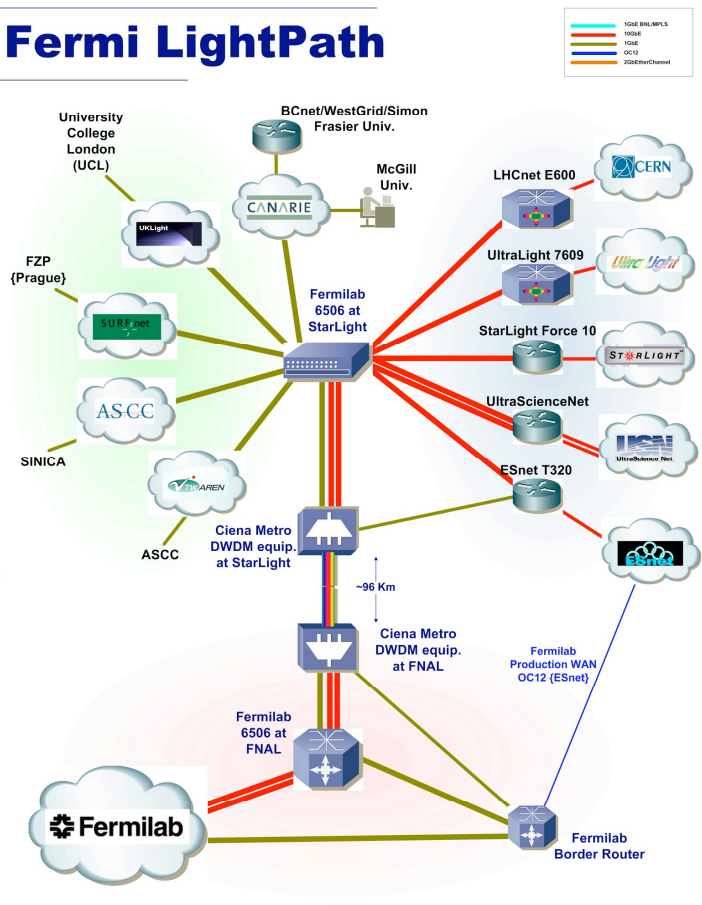


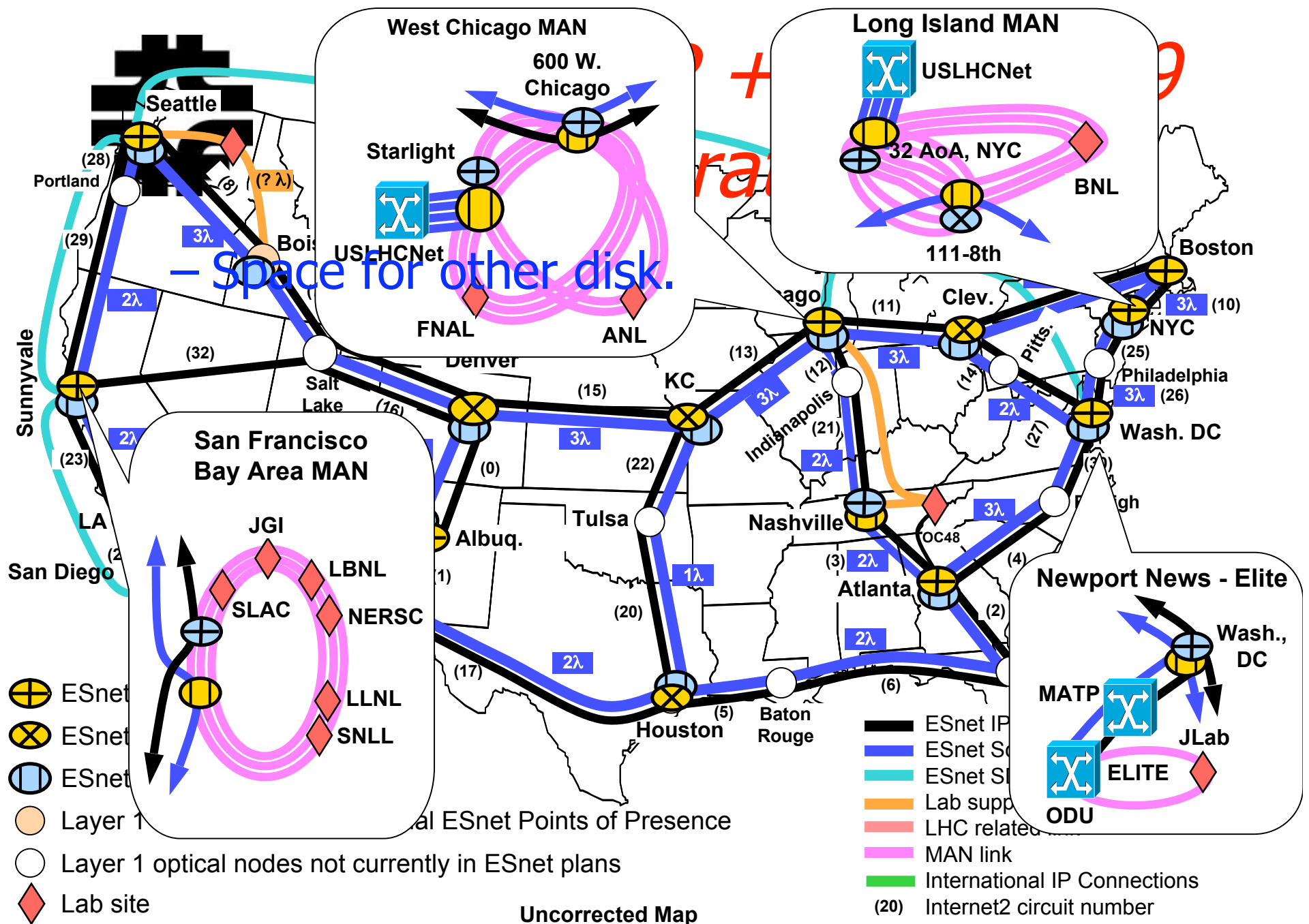
# *Which induces the need for networking*



+ Esnet MAN, and Wide Area Network R&D Group.

## **Fermi LightPath**

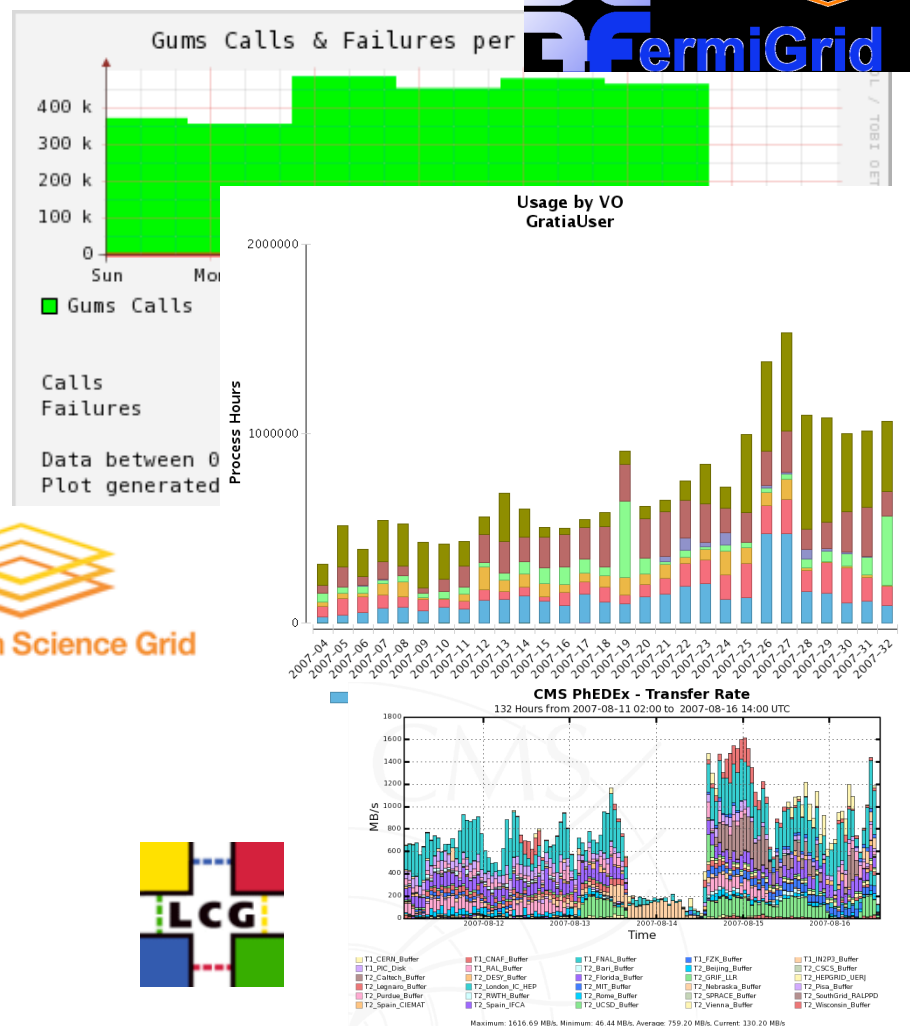


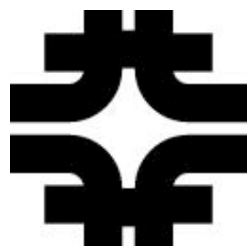




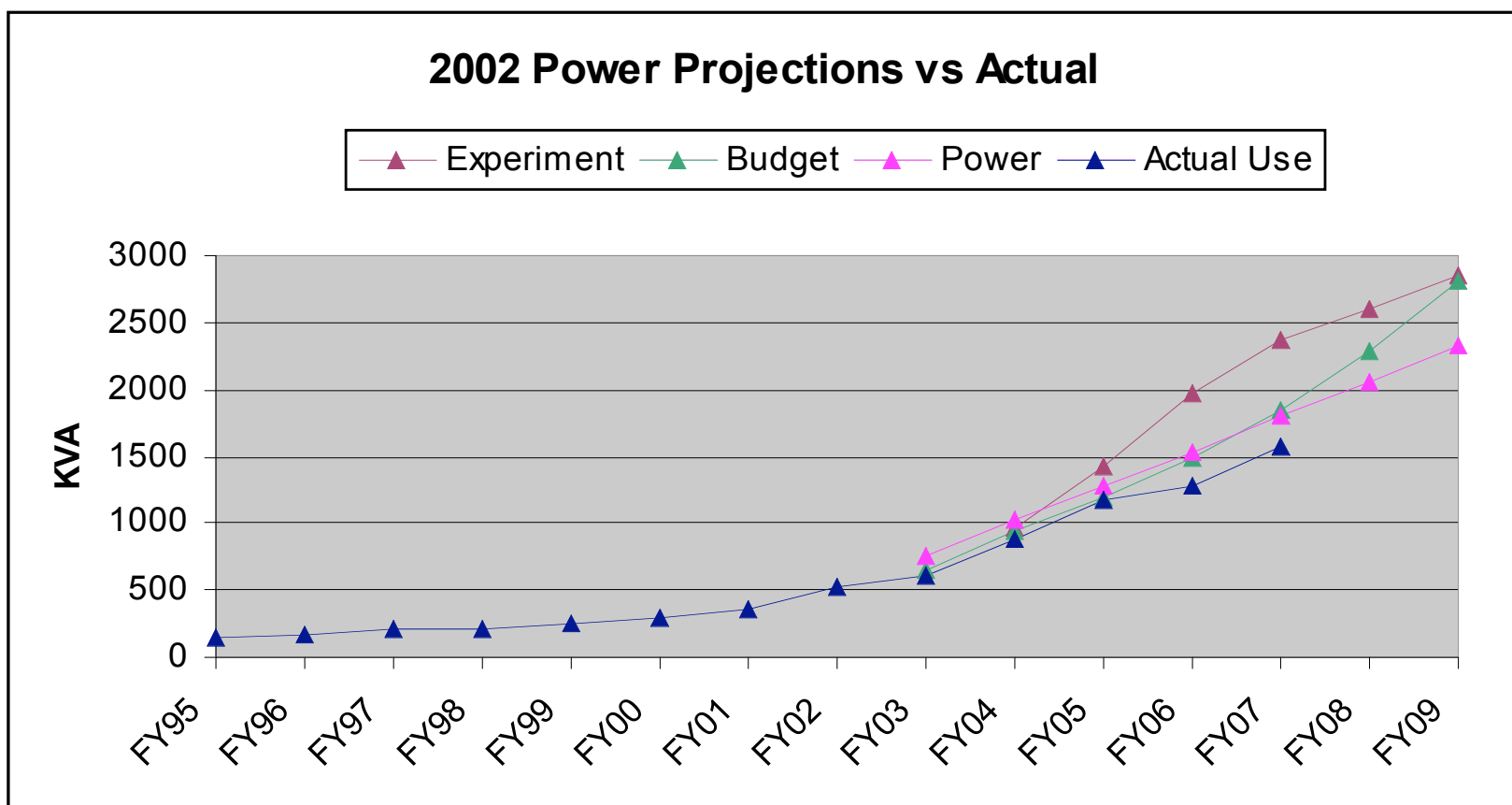
# *HEP capacity, adapted...*

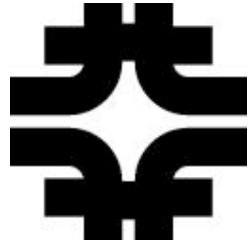
- HEP has adopted grid techniques as the basis for a world wide computing infrastructure.
- Both data and Jobs are shipped about.
- Fermilab leadership
  - Fermigrid -- campus
  - Open Science Grid - national,
  - WLCG grid scopes.





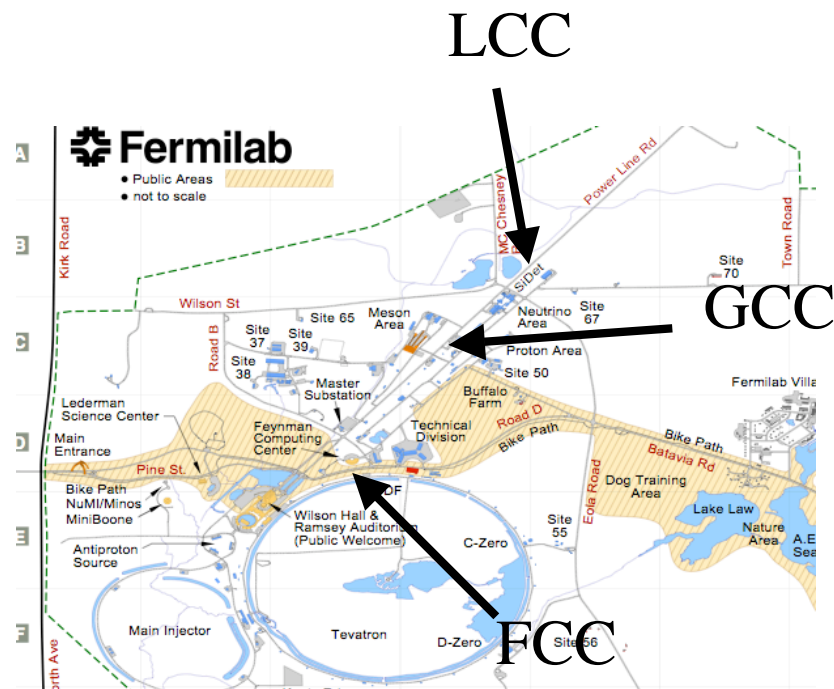
# *2002 Power Forecast*

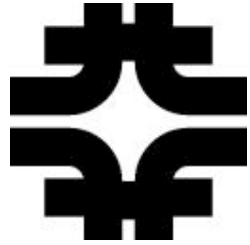




# *Computing Centers*

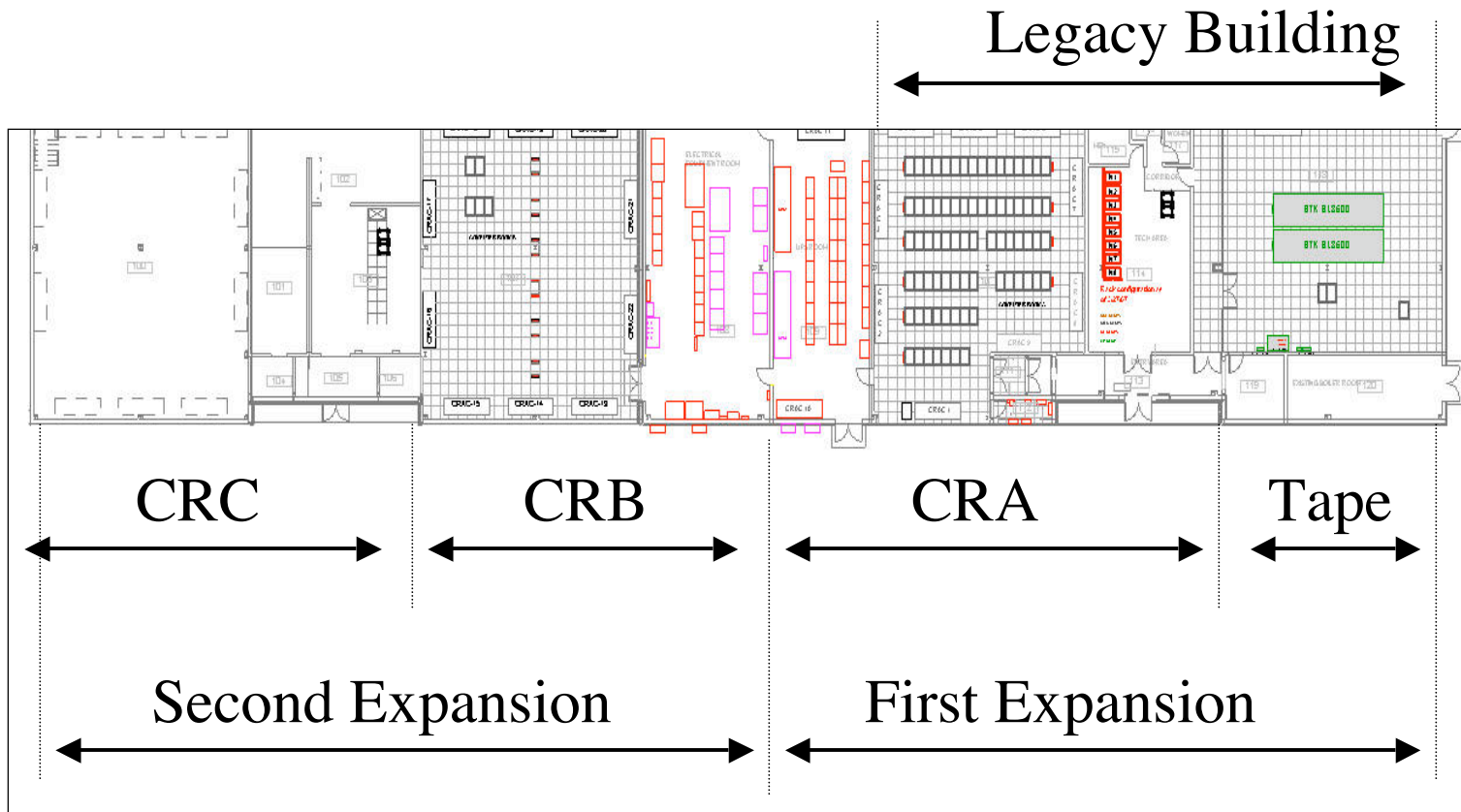
- Three computing buildings.
- FCC, -- > 20 year old purpose built
- LCC, GCC: built on former experimental halls w/ substantial power infrastructure.

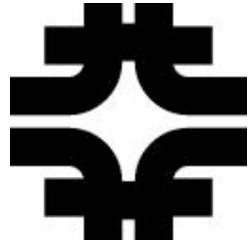




## *Type of Space*

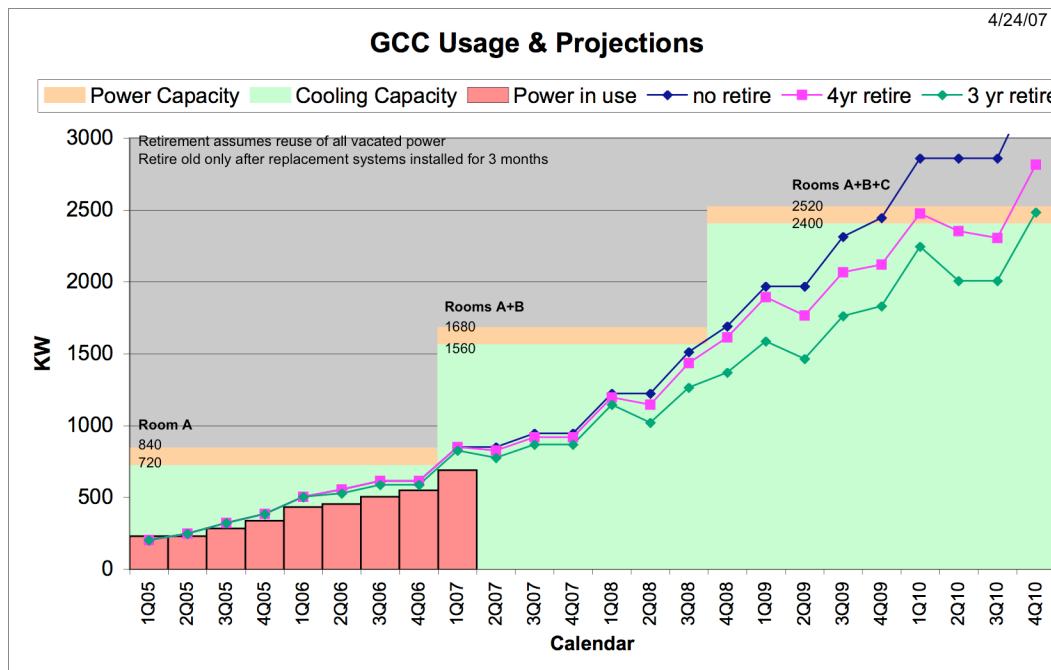
- Thinking continues to evolve, notion is that there is:
  - Space for new computing systems.
  - Space for long-lived, “tape” storage.
  - Space for generator backed disk.





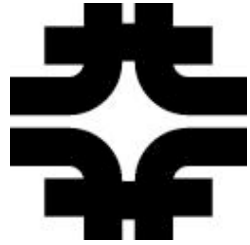
# *Just in Time Delivery*

KVA, excluding  
cooling



FCC	600
LCC	710
CRA	840
CRB	840
CRC	840
Tape	45
Total	3875





## *Summary*

- Fermilab has a diverse scientific computing program.
- Forecasting has shown a need to continually expand computing facilities.
- Fermilab has expanded its capacity incrementally.
- Notwithstanding that, the lab's program includes substantial future growth.